

## 2.2 Forging

- Forging is the operation where the metal is heated and the a force is applied to manipulate the metal in such a way that the required final shape is obtained.
- Forging is defined as the plastic deformation of metals at elevated temperatures into a predetermined size or shape using compressive forces exerted through some means of hand hammers, small power hammers, die, press or upsetting machine.
- It consists essentially of changing or altering the shape and section of metal by hammering at a temperature of about 980°C, at which the metal is entirely plastic and can be easily deformed or shaped under pressure.

## 2.3 Forging Types

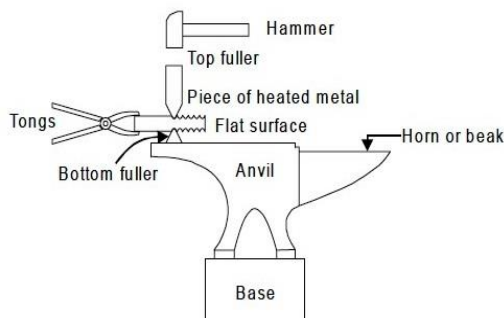
### a. Hand Forging or smith forging

The process involves heating the stock in the blacksmith's hearth and then beating it over the anvil. To get the desired shape, the operator

has to manipulate the component in between the blows. The types of forging operation available are fullering, flattening, bending and swaging. In fullering, the material cross-section is decreased and length increased. After fullering, the stock would have fullering marks left which are then cleared by means of flattening. To obtain specific shape such as round, square, hexagon etc. open crescent

Forging operations:  
Drawing out (fullering): operation in which metal get elongated with a reduction in the cross-sectional area. for this purpose, the force is to be applied in a direction, i.e. to the length axis.  
upsetting: This operation, increase the cross-sectional area of the stock at the expense of its length. To achieve the upsetting, force is applied in a direction parallel to the length axis.

purpose dies called wages are used. The force for shaping is applied by manual hammering or by means of the forging hammers. Smith forging involves a lot of skill on the part of the operator and also is more time consuming. this process is more beneficial in manufacturing of small lots or in trial production.



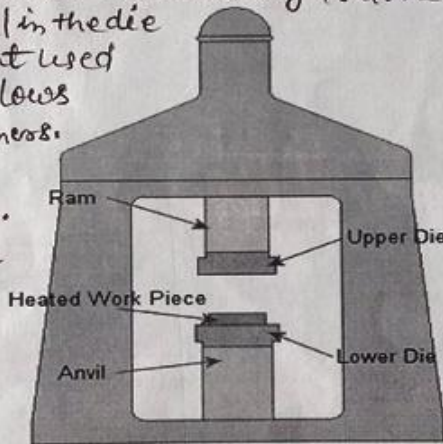
## (b) Drop Forging

- > Components obtained in drop forging are crank, crankshaft, connecting rod, crank hooks etc.
- > The final shape desired in drop forging cannot be obtained directly from the stock in a single pass. The various passes used are:

Fullering->Edging->Bending->blocking->Finishing->Trimming

Drop forging utilizes a closed impression die to obtain the desired shape of the component. The shaping is done by the repeated hammering given to the material in the die cavity. The equipment used for delivering the blows are called drop hammers.

Drop forging die consist of two halves. The lower half of the die is fixed to the anvil of the machine, while the upper half is fixed to the ram. The heated stock is



kept in the lower die while the ram delivers four to five blows on the metal, in quick succession so that the metal spreads and completely fill the die cavity. When the two die halves close, the complete cavity is formed. The die impressions are machined in the die cavity, because of which more complex shapes can be obtained in drop forging compared to Smith forging.

Q1 Stages involved in drop forging of lever

Fullering: 1st step is to reduce the stock to the desired size. The impression machined in the die to achieve this is called fullering impression.

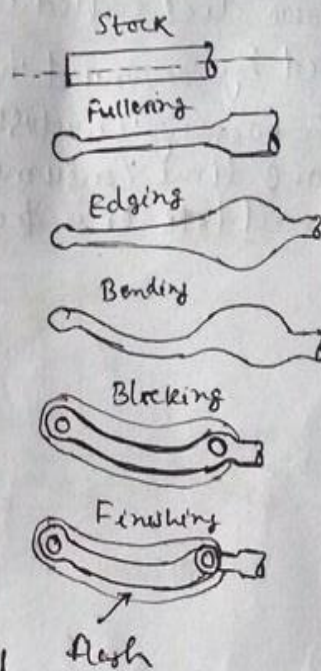
Edging impression: this stage is required to gather the exact amount of material required at each cross-section of the finished component.

Bending impression: this is required for those parts which have a bent shape.

Blocking impression: the part is then formed into the rough shape of lever using blocker die.

Finishing impression: this is the final impression where the actual shape required is obtained. In order to ensure that metal fill the die cavity, a little extra metal is added to the stock. This extra metal will form the flash and surround the forging in parting plane.

Trimming: In this stage the extra flash present around the forging is trimmed to get the forging in usable form.



### C. Press Forging

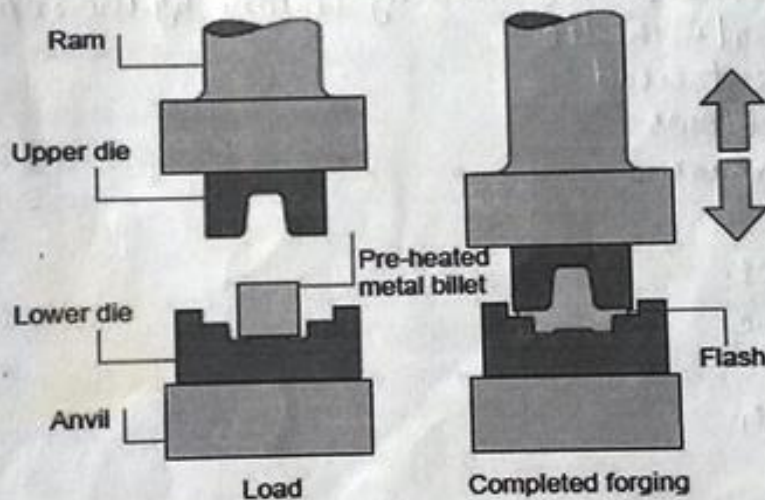
- In Press forging, the metal is shaped by means of a single continuous squeezing action. This squeezing is obtained by means of hydraulic presses.

Because of the continuous action of the hydraulic presses, material gets uniformly deformed throughout its entire depth.

- Presses capacity ranges from 5MN to 50 MN for normal application

For high capacity 150 MN

- The press forging dies is similar to drop forging dies with the various impressions such as fuller, bender, blocker and finisher operations properly arranged.

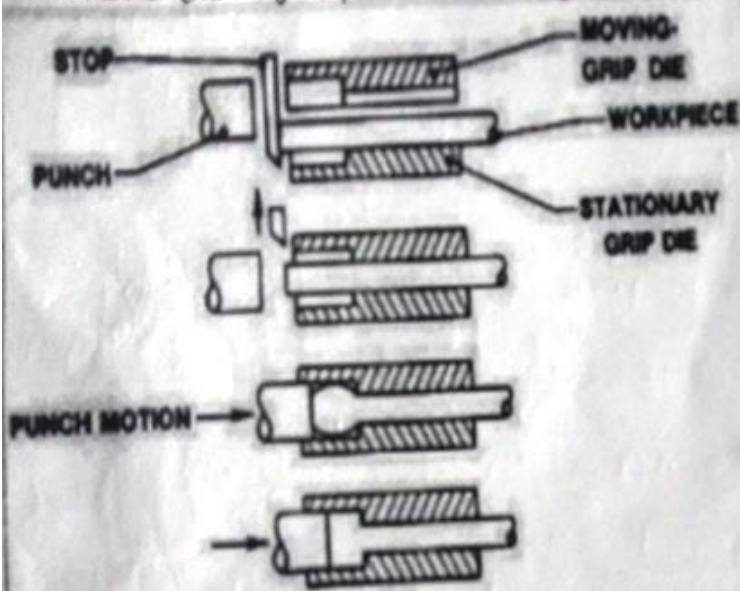


## PRESS FORGING

Press forging die are similar to drop forging die, In press forging the metal is shaped not by means of a series of blows as in drop forging, but by means of a single continuous squeezing action. This squeezing is obtained by means of hydraulic presses. Because of the continuous action of the hydraulic presses, the material get uniformly deformed throughout its entire depth.

The impression obtained in press forging are clean. Compared to drop forging components.

(d) Machine forging: It involves the upsetting operation so it is called as upset forging also. Originally this was developed for making the bolt heads in a continuous fashion but now there are fairly large number of diverse uses of this process. Because of the beneficial grain flow obtained from upsetting so it is used making gear blank, axles and similar parts. Generally it is horizontal acting. The die set consists of a die and a corresponding punch or a heading tool. The die consists of two part, one called the stationary gripper die which is fixed to the machine frame and the other, movable gripper die which moves along with the die slid of the up setter. The stock is held between these two gripper die by friction.



- In machine forging the material is only upset to get the desire shape.
- The die consists of two parts, one called the stationary gripper die which is fixed to the machine frame and the other movable gripper die which moves along with the die slide of the up setter. The stock is held then between these two gripper dies.
- It is used for making gears, blanks, shafts, excels, and similar parts.

Machine forging cycle starts with the movable die sliding against the stationary die to grip the stock. The two die when in closed position, form the necessary die cavity. Having completed the upsetting, the heading tool moves back to its back position. Then the movable gripper die releases the stock by sliding backwards. Similar to drop forging, it is not possible to get the final shape in a single pass in machine forging also. therefore operation is carried out in a number of stages. The stock is then moved from one stage to the other in a proper sequence till the final forging is ready.

#### 2.4 Forging Defects & Remedies

- Unfilled Sections
- Cold Shut
- Scale Pits
- Die Shift
- Flakes
- Improper grain flow